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# Devlopment of the Photosynthetic Genome

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**Abstract**

Endosymbiosis between a photosynthetic bacteria and a nonphotosynthetic host is now thought to have produced the earliest plastids. Many researchers favour a monophyletic hypothesis with a single initial endosymbiotic relationship involving a single endosymbiont and a single host. However, it has been suggested that the sequence-based trees used to support the monophyletic model are untrustworthy due to systematic biases in the sequence data, and that additional evidence is required before more complicated models can be ruled out. Such models might include the independent acquisition of closely related endosymbionts by closely related hosts, distantly related endosymbionts by distantly related hosts, and closely related endosymbionts by closely related hosts.

**Keywords:** *Lactobacillus* • APV • BV

## Introduction

Even if credible sequence-based trees were available, many of these scenarios would be difficult to differentiate from a monophyletic origin, depending on whether the trees were based on endosymbiont or host genes. Whether there was a single main endosymbiosis or numerous, it is obvious that a significant portion of the original endosymbiont genome was lost or moved to the nucleus. Plastids generally have 100-230 genes, although the original endosymbiont, an oxygenic photosynthetic bacterium, would have had a similar number of genes as modern cyanobacteria [1]. Synechocystis sp. PCC6803 has 3230 genes in its genome. There has been substantial discussion over why this transfer of genetic material happened and why it was confined to a part of the endosymbiont genome.

It has been proposed that genes in the plastid are exposed to large amounts of reactive, and potentially mutagenic, species produced during photosynthesis' electron transport events. Oxygen free radicals are one type of reactive species. It has also been proposed that relocating genes to the nucleus improves repair processes by putting the genes in a sexually reproducing and so recombining population. Although being in a sexual population should promote fitness according to the 'Muller's ratchet' concept, it needs to be determined if repair processes in the nucleus are intrinsically more successful than those in the plastid. Repair mechanisms have been proven in chloroplasts, and at least some repair activity is dependent on a plastid homologue of the RecA protein a key component of bacterial repair. We will examine an additional selection advantage hypothesised for gene migration to the nucleus further below [2].

If there are advantages to shifting genes from the plastid to the nucleus, why haven't all genes been transposed? It is probable that the tRNA-Glu gene is required for glutamate activation in tetrapyrrole production. However, because the tRNA-Glu might be produced by a nucleus-encoded plastid polymerase, the preservation of protein genes in the plastid is not required. To explain this, two major hypotheses have been offered. The first is that particular plastid proteins may be fundamentally difficult to transfer over the plastid membrane. It would thus be difficult to shift the genes for such proteins to the nucleus, resulting in protein synthesis in the cytosol and post-translational import into the organelle [3].

Several studies have shown, however, that individual plastid genes can be artificially introduced into the nucleus and, if the genes have been modified by fusing a region encoding a plastid-targeting sequence to the coding sequence for the mature protein, the resulting protein can be effectively re-imported into the organelle. Although these experiments indicate that these proteins can be re-imported into the organelle in theory, they do not rule out the potential that the necessity for import may cause a modest drop in organism fitness. A second reason for gene retention by the plastid is that it allows for quick control of expression in response to the organelle's redox status. The much-reduced dinoflagellate plastid genome will be discussed, as well as argue that its residual gene content is consistent with Allen's proposal [4.5].

## Conflict of Interest

None.

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